SHAPING THE FUTURE OF CONTROL

M4RTU

Remote Telemetry Unit

Specification

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OPTO 22

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RTU Features List

PRELIMINARY

Hardware

- *mistic* 200SX Controller Processing Power
- *mistic* 200 Multi-Function Digital and Analog I/O Brain Processing Power
- 1Meg FLASH (*mistic* Kernel/Cyrano Firmware/User Programs)
- 256K expandable to 2Meg (User Programs and/or Data)
- Real-time Clock and Watchdog Timers
- One RS-232 Port and one configurable RS-485 Port
- Base I/O (user definable per point): Digital 8, Analog 4
- Expansion I/O (User definable per point): Via Expansion Rack - Digital 8, Analog 4
  Via serial port - 256 standard *mistic* 200 I/O units
- Power Supply Options: DC - 12V, 24V, 48V, 125V
  AC - 120V, 240V
- System Monitors (Temperature, AC Operation, Battery Low, etc.)
- Three Expansion Slots
- New Modular Brick Package measuring: 6" x 11" x 6.5"
- Removable connector technology throughout for easy removal and maintenance

Software

- Cyrano 200 compatible (Up to 31 Flow Charts running simultaneously)
- Supports complete *mistic* 200 Multi-Function I/O (PIDs, Event Reactions, Counting, etc.)
- Remote Kernel (Operating System) FLASH download
- Remote Program (FLASH or RAM) download and debug
- Remote Data upload and download
- Modem Support (Direct/Lease/Radio)
- Peer-to Peer RTU Support (based on physical communication layer i.e. radio modems)
- Two way Dial-Up (Host to RTU, RTU to Host)
- RTU Broadcasting Support (based on physical communication layer i.e. radio modem)

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0.0 Introduction

To enhance Opto 22's market position into such markets as Waste Water Treatment, Well Monitoring, Tank Farms, Gas, and Petrol-Chemical, Engineering at Opto 22 is pursuing to define a specification for a Remote Telemetry Unit. The following specification document outlines the requirements necessary for the development of a RTU product. The product name for the RTU will be M4RTU. The intent of this specification is to determine the feasibility of such a product. The actual decision to implement the M4RTU will be based on this specification, a through cost analysis, marketing research, and production concerns.

The M4RTU will be a Remote Telemetry Unit based on Opto 22's *mistic* 200 product line. The base configuration of the M4RTU combines the primary features and functions of the LC32SX, a G4D16L (Digital Multi-Function Local Brick), and a G4A8L (Analog Multi-Function Local Brick) into one package. This technology will be combined with other unique features and functions found in RTU products throughout the industry. These include remote power needs, battery backup, environmental robustness, system monitors, I/O expansion, communications (modem support lease/direct/radio), and special software needs (Remote access and configuration, Peer-to-Peer, Broadcast, etc.).

The M4RTU will enable users to take Opto 22's revolutionary new approach to Computer Based Control into the RTU market place. Integrating the M4RTU into the *mistic* 200 System (family of processors) leverages the customer with Opto 22's powerful productivity tool Cyrano 200. Thus applications may be developed in less time. They may also be developed and tested on other *mistic* 200 products and then ported to the actual M4RTU hardware being used. Along with other distinct advantages in the *mistic* 200 System (e.g. Event Reaction, PIDs, Distributive Processing, Point Flexible I/O, String Handling, Communications, etc.) the user is able to control architectural needs, performance requirements, and cost factors.

The primary design methodology driving the M4RTU specification is modularity. The M4RTU will be designed to act as the primary control element in a RTU application. Support elements such as NEMA enclosures, power systems, battery backup, terminals, modems, and radio gear will be left up to the End User or RTU Integrator. Industry standard interfaces will be employed to insure multi-vendor support of the various support elements. Employing this thinking allows the user to utilize the best of breed cost effective technology needed to meet the requirements of their RTU application.

1.0 Packaging

The M4RTU will incorporate a packaging philosophy similar to the current *mistic* 200 form factor which, minimizes packaging cost, is easy to install, is independent of mounting orientation (horizontal or vertical), and provides flexibility when determining the overall RTU system. Package modularity shall be stressed providing future product growth while maintaining a good price versus performance ratio. To accomplish this an extrusion package methodology shall be used. The basic packaging components will be an "Extrusion", housing the electronics, "End Caps", to enclose the extrusion ends, and a "Beauty Cover", to protect the unit. The packaging shall meet all UL, FM, VDE, and Class 1 Dev 2 requirements.

1.1 Dimensions

The overall dimensions of the M4RTU shall not exceed the following:

Width: 6"
Length: 11.5"
Height: 6.50"

1.2 Extrusion

The main component of the M4RTU package will be an aluminum extrusion. The extrusion shall house the base level I/O, controller/brain circuitry, power supply, and up to three expansion daughter card options. Provisions shall be made also to house a vertical passive back plane PCB (M4 Bus). The extrusion shall have mounting ears containing captive mounting hardware. The sides of the extrusion shall be finned for cooling and aesthetics. Features for tap holes shall be provided for "End Cap" mounting. The extrusion shall also contain features to capture a "Beauty Cover". Spacing of the PCBs within the extrusion shall be based on agency and connector requirements. The extrusion shall be de-burred, cleaned, brushed, and black anodized.

1.3 End Caps

The end caps shall be constructed of stamped sheet metal to close the ends of the extrusions and provide external connector mounting surfaces. A modular design shall be employed to allow the plugging of up to three expansion daughter card options and various "Beauty Cover" designs. A uniquely stamped end cap shall be designed for each expansion daughter card option and it's associated connectors, but shall not dictate it's placement within the extrusion. The width of the end caps shall cover the entire extrusion width including the fins. The end caps shall be de-burred, cleaned, brushed, and black anodized

1.4 Beauty Cover

A beauty cover shall be incorporated to give aesthetic appeal, protect the unit, and provide dead front end protection. The cover shall be constructed of stamped sheet metal. Quick disconnect screw technology shall be used to connect the cover to the end caps. The beauty cover shall be labeled in the same artwork as other *mistic* 200 products and shall identify any accessible items. In conjunction with the proper end caps various beauty covers shall be available for different access and application needs. The beauty cover shall be de-burred, cleaned, brushed, and black anodized

1.5 Environmental

The M4RTU packaging shall conform to the following environmental specifications:

Operating Temperature: 0°C to 70°C

Storage Temperature: -40°C to 100°C

Shock/Vibration: SAMA PMC31.1, Paragraph 5.4 and Condition 3, 5 to 2000Hz

Transient Protection: IEEE C37.90.1-1989

EMI Susceptibility: IEC 801-2, level 3 and SAMA PMC33.1-1978, 2-abc, 1% of reading

EMI Emissions: FCC47FCR, Part 15, Subpart J, Class A verified

Intrinsic Environment: Class 1 Dev 2

Agencies: UL, FM, VDE

1.6 Shielding

Shielding shall be provided to isolate the I/O board, containing the field wiring connections, from the other circuitry located on the other boards. Proper shielding shall also be incorporated in the design of the power supply system.

2.0 Power

The M4RTU power system shall utilize a modular plug style design, enabling the user to select from a family of M4RTU power supplies. The power system shall power user I/O (non-field side), controller/brain, and expansion daughter card circuitry. The power system shall protect the M4RTU from noise, transients, and improper wiring. A power bus shall be incorporated into the vertical passive back plane PCB (M4 Bus) to carry power to the various M4RTU sub systems. The power system shall be flexible enough to allow user defined external power supplies or sources, battery backup operation, and AC adapter operation. The power system shall comply with all UL, FM, and VDE requirements.

2.1 Power Bus Requirements (M4 Bus)

The M4RTU power bus shall have the ability to distribute the following voltages:

+ 5.0 VDC
+/- 12.0 VDC
+ 24 VDC

Separate digital and analog grounds shall also be provided.

2.2 Base Level Voltage & Current Requirements

The following tables list the required voltages and currents for the base level M4RTU:

Voltage: 5VDC	Currents
I/O Board	0.25 amps
Ctrl/Brain Board	2.00 amps
Expansion Boards	1.50 amps
Total	3.75 amps

Voltage: 24VDC	Currents
I/O Board	0.40 amps
Ctrl/Brain Board	0.00 amps
Expansion Boards	0.00 amps
Total	0.40 amps

2.3 Power Supply Family

The following is a list containing the various power supply options that shall be available in the M4RTU power supply family:

DC	AC
12V	120V
24V	240V
48V	
125V	

2.4 Design Criteria

The power system design criteria shall be based on obtaining the best reliability and maximum efficiency at the best price versus performance ratio. The design shall conform to the space provided in the extrusion. Heat generated by the power supply must be driven out of the extrusion. The power supply shall not interfere mechanically or electrically with the remaining M4RTU sub-systems or circuitry.

2.5 Field Wiring

Field wiring electrical supply requirements shall be user defined per RTU application. External power supply sources shall be used to formulate an isolation barrier (G4 I/O) with the external world. Field wiring shall comply with current *mistic* 200 Brick and G4 module wiring standards.

2.6 Battery Backup

All program RAM memory shall have the same battery backup capability as the current *mistic* 200 Processors designs. Provisions shall be made for external battery back up capability of the entire M4RTU.

3.0 Hardware

The M4RTU shall be designed around the technology used in the LC32SX *mistic* Processor, the G4D16L (Digital Multi-Function Local Brick), and the G4A8L (Analog Multi-Function Local Brick). The overall architecture shall consist of an I/O board, a Processor board, a Power Supply, and a M4 Bus board.

3.1 I/O Board

The I/O board shall contain circuitry and real-estate to accommodate eight G4 Digital I/O modules, four G4 Analog I/O modules, jumpers for various user configurables (i.e. address, baud rates, etc.), LED monitors (i.e. RUN, Communications, etc.), Field Wiring connectors, RAM Battery Backup, and a I/O to Processor board connector. Either a separate I/O board or a RTU/Expansion I/O combination board must be designed for an I/O Expansion Brick. Refer to I/O Section.

3.2 Processor Board

The Processor board shall contain circuitry and real-estate to accommodate a *mistic* 200SX Processor, a G4 Brain Board Processor, a Quart Communication Processor, a FIFO Local Bus (confined to two Local Bus Addresses 0 and 1), a Digital ASIC, an Analog ASIC, System Monitors, a Real-time Clock, two Serial Ports, Memory (FLASH, RAM, and E^2PROM), and a M4 Bus interface. The following table indicates minimum processor and system memory requirements.

	mistic Processor	Brain Processor
Processor	EC68020, 16MHz	80196KR, 16MHz
FLASH or EPROM	256K or 1Meg	64K or 128K
RAM	256K or 1Meg	32K
E^2PROM (serial)	None	4K

3.3 Power Supply Board

The Processor board shall contain circuitry and real-estate to accommodate a power supply as outlined in the Power Section. Refer to the Power Section 2.0 for details.

3.4 M4 Bus Board

The M4RTU shall incorporate an M4 Bus. The M4 Bus board used in the M4RTU shall conform to the M4 Bus specification. It shall contain the circuitry and real-estate to accommodate three M4 Bus options cards, connection to the Processor Board, and connection to the Power Supply. Refer to the M4 Bus specification for details.

3.5 System Monitors

The following system monitors shall be available:

Host Communication Establish - used to detect Host Communications

Watch Dog Timers - used to detect communication errors (e.g. processors, I/O, etc.)

Operating Temperature - used to monitor RTU operating temperature

Power Supply Operating - used to detect main power supply operation

Power Battery Low - used to monitor battery backup supply

RAM Battery Backup Low - used to monitor RAM battery backup

All system monitors shall be accessible via Cyrano 200 as system variables, system I/O, or as system events. Users shall be able to set up Event/Reactions based on system monitors.

4.0 I/O

The M4RTU shall use Opto 22's standard G4 I/O modules. The I/O structure shall be the same User Definable Point Resolution capability that is used in the Digital Multi-Function and the Analog Multi-Function Local Bricks. The field wiring shall incorporate top mounted plug style terminal blocks for easy access to field wiring and easy removal of the entire M4RTU. The standard Panduit Channel integrated into a *mistic* 200 Brick Base shall not be incorporated.

4.1 Brain Power

A 80196KR shall be used as the Brain Board Processor. The Brain Board Processor shall be connected to one Digital Multi-Function ASIC and one Analog Multi-Function ASIC. Each ASIC shall perform the same functions as there current *mistic* 200 Brick counter parts. FLASH memory and serial E^2PROM shall be employed to house the Brain Board Processor Kernel and configuration data. Refer to the Hardware Section 3.0 for details.

4.2 Base RTU I/O Configuration

The Base RTU I/O configuration shall be as follows:

	Digital	Analog
Base Unit I/O	8pts	4pts

The M4RTU shall be packaged without any G4 I/O modules installed. Only the above stated I/O locations shall be available in the minimum Base RTU I/O configuration. Their functions will be based on the application and system monitor requirements as defined by the user.

4.3 Local I/O Expansion

The Local I/O in the M4RTU shall be expandable via a M4RTU I/O Expansion Brick. The Expansion Brick shall have 8 Digital Point and 4 Analog Point locations. Together with the Base RTU I/O, the Expansion Brick completes a full complement of Digital and Analog Multi-Function Brick I/O ASIC capacity. The Expansion Brick shall have the same form factor and mounting as the M4RTU and utilize the same extrusion packaging concepts. The M4RTU shall attach to the Expansion Brick via an Opto 22 supplied shielded cable assembly. Power for the Expansion Brick shall be derived from a second power supply located in the Expansion Brick. The power supply shall have the same form factor and capability as the power supply utilized in the M4RTU. Refer to the Power Section 2.0 for details. The Expansion Brick I/O Board shall either be a second I/O board or a RTU/Expansion I/O combination board. Field wiring connections shall be the same as for the base M4RTU I/O.

4.4 Remote I/O Expansion

A second method for expanding the M4RTU's I/O shall be via a *mistic* 200 Remote I/O Bus. One *mistic* 200 Remote I/O Bus shall be configurable from either the provided RS-485 link or a planned Daughter Board containing several RS-232/485 links. All *mistic* 200 Remote I/O Brick products may be attached in this manner to expand the I/O capability of the M4RTU.

5.0 Communications

The M4RTU will solve several different communication RTU requirements. These include a Host Port, a Programming Port, modem support options, user defined serial links, a *mistic* 200 Remote I/O Bus link, and various protocol support.

5.1 Base RTU Communications

The M4RTU shall come standard with one RS-232 communication link and one RS-485 communication link on the Processor board. The RS-232 link shall be modem compatible. The RS-485 link shall be compatible with a *mistic* 200 Remote I/O Bus. The user shall be able to define how the two provided base communication links are used (i.e. Host Port, mistic 200 I/O Remote Bus Port, User Defined Port, etc.).

5.2 Communication Expansion

The communication capability of the M4RTU shall be expandable via daughter board option cards. These cards shall plug into one of the three M4 Bus slots. The following communication daughter cards may or may not coincide with the development of the M4RTU:

M4ARC - Arcnet Daughter Card
M4SER - Serial Daughter Card (two ports)
M4CCP - Communication Co-Processor (user definable port)

5.3 Modem Support

Support for various modems (Direct/Lease/Radio) shall be provided. Initially modem support shall be via the RS-232 communication port. Development of a internal M4RTU modem daughter card will depend on marketing and engineering factors.

5.4 Protocols

Various communication protocols shall be supported based on the RTU market.
(i.e. HART, REDAC, etc.)

6.0 Software

6.1 *mistic* MMI

The M4RTU shall be compatible with the *mistic* MMI. Extensions to the *mistic* MMI shall be created to support the M4RTU as necessary.

6.2 Cyrano 200

The M4RTU shall be compatible with Cyrano 200 as it pertains to the LC32SX. Extension to Cyrano 200 and the *mistic* Kernel shall be created to support the M4RTU as necessary.

6.3 Multiple Host Ports

True Multiple Host ports is essential. The user must be able to configure the number and type (i.e. RS-232, RS-485, Arcnet) of Multiple Host ports via Cyrano 200. Multiple Host ports must allow remote and/or local access, reconfiguration, kernel update (FLASH), program download (FLASH or RAM), program debug, data upload, data download, and multiple MMIs. Communicating via the various Multiple Hosts shall be transparent with respect to transmission method (i.e. Arcnet, RS-232, Modems, etc.) and location Local or Remote.

6.4 Modem Support

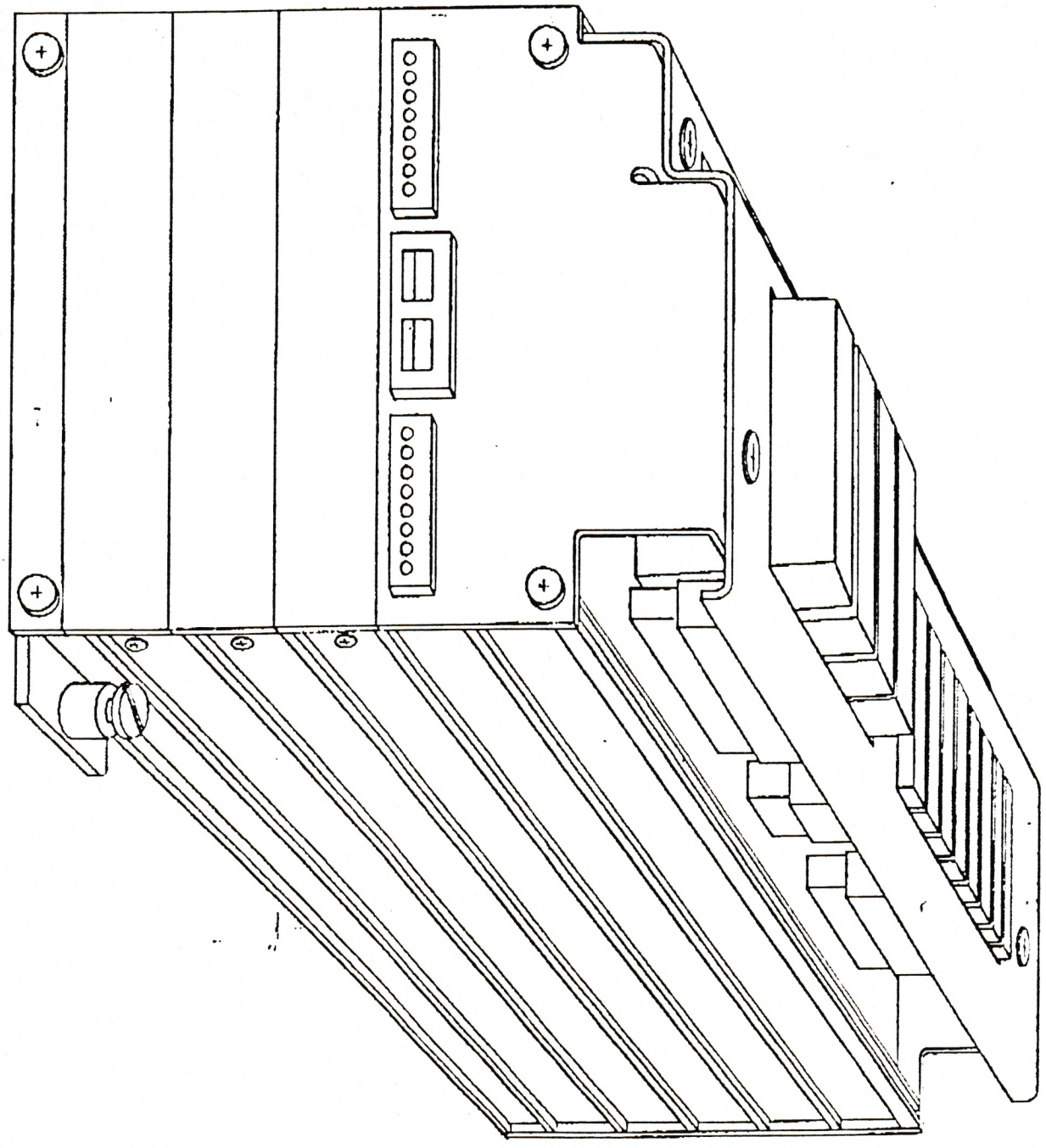
The *mistic* MMI, Cyrano 200, and *mistic* Kernel shall be extended to support various modem types including Direct, Lease, and Radio. Two way dial-up shall be supported (Host-to-RTU, RTU-to-HOST). Event/Reactions or Watchdog timers shall be used to detect communication problems.

6.5 Peer-to-Peer

Multiple M4RTUs shall be configurable as a Peer-to-Peer network assuming the physical layer can support Peer-to-Peer communications (i.e. Arcnet, Radio modems, etc.). The Peer-to-Peer network shall support RTU Broad-Casting (One RTU to many concept).

6.6 SCADA

All relative SCADA information shall be available via the Multiple Host Ports

6.7 Hardware Support

Software shall be developed for the *mistic* MMI, Cyrano 200, *mistic* Kernel, Protocol converters, and drivers as needed to support System Monitors (refer to section 3.5), planned and future hardware.